2521/105
2601/106
ELECTRICAL MEASUREMENTS
AND ANALOGUE ELECTRONICS
Oct./Nov. 2011
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

# DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING
## (POWER OPTION)
## MODULE I

ELECTRICAL MEASUREMENTS AND ANALOGUE ELECTRONICS

**3 hours**

**INSTRUCTIONS TO CANDIDATES**

*You should have the following for this examination.*

*Answer booklet;*
*Drawing instruments;*
*Scientific calculator/mathematical tables.*

*This paper consists of **TWO** sections **A** and **B**.*
*Answer any **THREE** questions from section **A** and **TWO** questions from section **B**.*
*All questions carry equal marks.*
*Maximum marks for each part of a question are as shown.*

**This paper consists of 5 printed pages.**

**Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.**

## SECTION A

*Answer any **THREE** questions from this section.*

1. (a) State the SI unit of measure for the following quantities:

(i) Length;
(ii) Time;
(iii) Volume;
(iv) Mass. (2 marks)

(b) Describe the following types of instrumental errors:

(i) observational;
(ii) random. (8 marks)

(c) (i) A voltmeter having a sensitivity of 1000Ω/V reads 100V on its 150V scale when connected across an unknown resistor in series with a milliammeter. If the milliammeter reads 5mA, determine:

I. Apparent resistance of the unknown resistor;
II. Actual resistance of the unknown resistor;
III. Error due to the loading effect of the voltmeter.

(ii) The value of unknown resistance of a wheatstone bridge is given by:

$$R_X = \frac{R_2 R_3}{R_1}. \quad \text{If } R_1 = 100 \pm 0.5\%\Omega$$

$R_2 = 1000 \pm 0.5\%\Omega$, and $R_3 = 840 \pm 0.5\%\Omega$, determine:

I — Magnitude of the unknown resistance.
II — Limiting error; for the unknown resistance. (10 marks)

2. (a) State "Hall effect" with reference to magnetism. (2 marks)

(b) With the aid of a diagram, explain how a fluxmeter is used to measure flux density and hence derive the flux density equation. (12 marks)

(c) With the aid of a circuit diagram, explain how inductance is measured using Maxwell's inductance - capacitance Bridge. (6 marks)

3. (a) With the aid of diagrams, explain the following faults with reference to electrical circuits.

(i) open circuit;
(ii) short circuit.

(4 marks)

(b) Distinguish between operation and maintenance manuals as refers to electrical machines.

(4 marks)

(c) Explain the following maintenance principles:
(i) scheduled maintenance;
(ii) preventive maintenance;
(iii) corrective maintenance.

(10 marks)

(d) Explain how faults can be identified on a PCB (Printed Circuit Board) (2 marks)

4. (a) (i) Define the following terms with reference to systems:

I. Reliability;
II. Failure.

(ii) Explain **four** causes of failure. ( 6 marks)

(b) Explain the following reliability indices:

(i) Mean time between failure;
(ii) Mean time to failure;
(iii) Maintainability;
(iv) Availability.

(8 marks)

(c) With the aid of a diagram, explain failure periods. (4 marks)

(d) The MTBF of a certain equipment is 500-hours. Determine the probability of failure of a similar equipment in:

(i) 100 - hours of life;
(ii) 1000 - hours of life.

(2 marks)

## SECTION B

*Answer any **TWO** questions from this section.*

5. (a) (i) Define the following terms:

I. Proton; -> It is positive Electrons in an atom.

II. Neutron. -> It is Negative Electrons in an atom.

(ii) Distinguish between excited and ionized atoms. (6 marks)

(b) With the aid of a diagram, explain the principle of operation of a cathode ray osalloscope. (14 marks)

6. (a) Distinguish between intrinsic and extrinsic semiconductor. (4 marks)

Intr-> is current in pure semi-conductor is small and has be charged & Stream & free Electron and holes going opposite direction.

(b) With the aid of a labelled circuit diagrams, explain forward and reverse bias of a PN function diode. (16 marks)

7. (a) With the aid of symbols differentiate between PNP and NPN transistors: (6 marks)

(b) With aid of a circuit diagram, derive currents relationship in a common emitter PNP configuration. (12 marks)

$I_C = I_E$ $I_C = \alpha I_B$ $\beta =$

$I_E = I_C + I_B$

(c) The following currents were obtained in a transistor connected in Common Base (CB) configuration:

$\alpha$

$\beta$

$I_E = 2mA$, $I_B = 20mA$. Determine the values of $\alpha$ and $I_C$ (2 marks)

PNP

$I_C = I_E + I_B$

NPN

P.N.P

Proton -> +ve charges of an atom

Neutron - -ve charges

proton + electron = Neutral

$\alpha = \frac{I}{I+\alpha}$

proton + electron - electrons

$\frac{I_C}{I_E} = \alpha$

$I_C = \beta I_B$

8. (a) State **four** advantages of FETS (Field Effect Transistors). (4 marks)

(b) Figure 1 shows a common drain JFET Amplifier.
If $r_d = 100k\Omega$, $g_m = 300\mu s$ *and* $R_L = 10k\Omega$, determine:

(i) voltage gain;
(ii) output resistance. (4 marks)

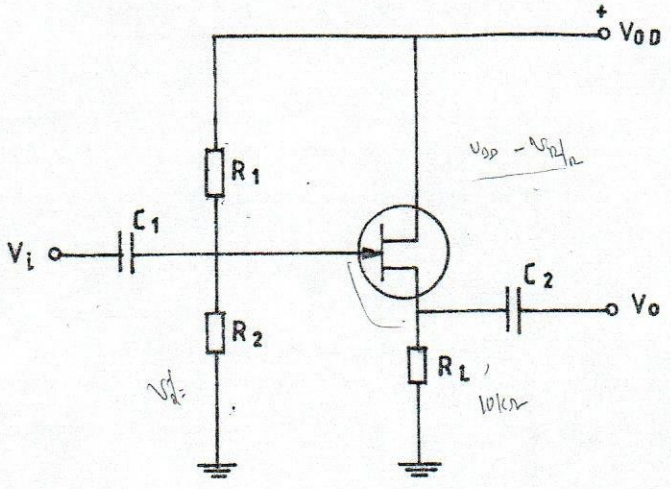


Fig.1

(c) With the aid of a labelled diagram, explain the operation of a $\Pi$ — fitter. (5 marks)

(d) With the aid of a labelled diagram, explain the operation of a Zener diode shunt regulator and derive the expression for the regulator resistance. (7 marks)